Complete Summary

GUIDELINE TITLE

Guidelines on the management of valvular heart disease.

BIBLIOGRAPHIC SOURCE(S)

Vahanian A, Baumgartner H, Bax J, Butchart E, Dion R, Filippatos G, Flachskampf F, Hall R, Iung B, Kasprzak J, Nataf P, Tornos P, Torracca L, Wenink A, Priori SG, Blanc JJ, Budaj A, Camm J, Dean V, Deckers J, Dickstein K, Lekakis J, McGregor K, Metra M, Morais J, Osterspey A, Tamargo J, Zamorano JL, Zamorano JL, Angelini A, Antunes M, Fernandez MA, Gohlke-Baerwolf C, Habib G, McMurray J, Otto C, Pierard L, Pomar JL, Prendergast B, Rosenhek R, Uva MS, Tamargo J. Guidelines on the management of valvular heart disease: The Task Force on the Management of Valvular Heart Disease of the European Society of Cardiology. Eur Heart J 2007 Jan;28(2):230-68. [232 references] PubMed

GUIDELINE STATUS

This is the current release of the guideline.

**** REGULATORY ALERT ****

FDA WARNING/REGULATORY ALERT

Note from the National Guideline Clearinghouse: This guideline references a drug(s) for which important revised regulatory and/or warning information has been released.

- July 31, 2008, Erythropoiesis Stimulating Agents (ESAs): Amgen and the U.S. Food and Drug Administration (FDA) informed healthcare professionals of modifications to certain sections of the Boxed Warnings, Indications and Usage, and Dosage and Administration sections of prescribing information for Erythropoiesis Stimulating Agents (ESAs). The changes clarify the FDA-approved conditions for use of ESAs in patients with cancer and revise directions for dosing to state the hemoglobin level at which treatment with an ESA should be initiated.
- February 28, 2008, Heparin Sodium Injection: The U.S. Food and Drug Administration (FDA) informed the public that Baxter Healthcare Corporation has voluntarily recalled all of their multi-dose and single-use vials of heparin sodium for injection and their heparin lock flush solutions. Alternate heparin manufacturers are expected to be able to increase heparin production sufficiently to supply the U.S. market. There have been reports of serious adverse events including allergic or hypersensitivity-type reactions, with symptoms of oral swelling, nausea, vomiting, sweating, shortness of breath, and cases of severe hypotension.

- November 8, 2007 and January 3, 2008 Update, Erythropoiesis Stimulating Agents (ESAs): The U.S. Food and Drug Administration (FDA) notified healthcare professionals of revised boxed warnings and other safety-related product labeling changes for erythropoiesis-stimulating agents (ESAs) stating serious adverse events, such as tumor growth and shortened survival in patients with advanced cancer and chronic kidney failure.
- August 16, 2007, Coumadin (Warfarin): Updates to the labeling for Coumadin to include pharmacogenomics information to explain that people's genetic makeup may influence how they respond to the drug.

COMPLETE SUMMARY CONTENT

SCOPE

DISEASE/CONDITION(S)

Valvular heart disease, including:

- Aortic regurgitation
- Aortic stenosis
- Mitral regurgitation (organic and ischaemic)
- Mitral stenosis'
- Tricuspid stenosis
- Tricuspid regurgitation
- Combined and multiple valve disease

GUIDELINE CATEGORY

Diagnosis
Evaluation
Management
Risk Assessment
Treatment

CLINICAL SPECIALTY

Cardiology
Internal Medicine

Obstetrics and Gynecology
Pediatrics
Surgery

INTENDED USERS

Physicians

GUIDELINE OBJECTIVE(S)

To present management recommendations based on all of the relevant evidence on management of valvular heart disease in order to help physicians select the best possible management strategies for the individual patient suffering from valvular heart disease, taking into account the impact on outcome and also the risk-benefit ratio of a particular diagnostic or therapeutic procedure

TARGET POPULATION

Adults and adolescents with valvular heart disease, including pregnant women with valvular heart disease

Note: The guidelines do not deal with endocarditis and congenital valve disease.

INTERVENTIONS AND PRACTICES CONSIDERED

Evaluation/Risk Assessment

1. Clinical evaluation
2. Echocardiography (transoesophageal and transthoracic)
3. Fluoroscopy
4. Radionuclide angiography
5. Stress testing (exercise electrocardiogram, exercise echocardiography, pharmacologic stress tests)
6. Other imaging, including computed tomography and magnetic resonance imaging
7. Measurement of biomarkers such as natriuretic peptide serum level
8. Coronary angiography
9. Cardiac catheterization
10. Assessment of comorbidity
11. Risk stratification

Management/Treatment

1. Surgery
    - Aortic and mitral valve replacement or valve repair
    - Balloon valvuloplasty
    - Percutaneous balloon commissurotomy
    - Percutaneous balloon tricuspid dilatation
2. Medical therapy
    - Nitroprusside
    - Inotropic agents

    - Angiotensin-converting enzyme (ACE) inhibitors
    - Dihydropyridine calcium channel blockers
    - Beta-blockers
    - Diuretics
    - Anticoagulants to maintain target international normalized ratio (INR)
    - Endocarditis prophylaxis
3. Serial testing (scheduled follow-up)
4. Management of special populations
5. Individualized choice of prosthetic valve (bioprosthetic or mechanical)
6. Management after valve replacement
    - Antithrombotic management, including antiplatelet drugs and interruption of anticoagulant therapy
    - Management of valve thrombosis
    - Management of thromboembolism
    - Management of haemolysis and paravalvular leak
    - Management of bioprosthetic failure
    - Management of heart failure
7. Management during non-cardiac surgery
8. Management during pregnancy

MAJOR OUTCOMES CONSIDERED

- Utility of diagnostic tests
- Operative mortality
- Survival
- Preservation of left ventricular function
- Long-term morbidity
- Probability of durable valve repair

METHODOLOGY

METHODS USED TO COLLECT/SELECT EVIDENCE

Searches of Electronic Databases

DESCRIPTION OF METHODS USED TO COLLECT/SELECT THE EVIDENCE

A literature review was performed using Medline (PubMed) for peer-reviewed published literature focusing on the studies published within the last 10 years. The use of abstracts was avoided in these guidelines.

NUMBER OF SOURCE DOCUMENTS

Not stated

METHODS USED TO ASSESS THE QUALITY AND STRENGTH OF THE EVIDENCE

Weighting According to a Rating Scheme (Scheme Given)

RATING SCHEME FOR THE STRENGTH OF THE EVIDENCE

Levels of Evidence

Level of Evidence A: Data derived from multiple randomized clinical trials or meta-analyses

Level of Evidence B: Data derived from a single randomized clinical trial or large non-randomized studies

Level of Evidence C: Consensus of opinion of the experts and/or small studies, retrospective studies, registries

METHODS USED TO ANALYZE THE EVIDENCE

Review of Published Meta-Analyses
Systematic Review

DESCRIPTION OF THE METHODS USED TO ANALYZE THE EVIDENCE

Not stated

METHODS USED TO FORMULATE THE RECOMMENDATIONS

Expert Consensus

DESCRIPTION OF METHODS USED TO FORMULATE THE RECOMMENDATIONS

Not stated

RATING SCHEME FOR THE STRENGTH OF THE RECOMMENDATIONS

Classes of Recommendations

Class I: Evidence and/or general agreement that a given treatment or procedure is beneficial, useful, and effective

Class II: Conflicting evidence and/or a divergence of opinion about the usefulness/efficacy of a given treatment or procedure

> **Class IIa**: Weight of evidence/opinion is in favour of usefulness/efficacy
>
> **Class IIb**: Usefulness/efficacy is less well established by evidence/opinion

COST ANALYSIS

A formal cost analysis was not performed and published cost analyses were not reviewed.

METHOD OF GUIDELINE VALIDATION

External Peer Review
Internal Peer Review

DESCRIPTION OF METHOD OF GUIDELINE VALIDATION

Once the document has been finalized and approved by all the experts involved in the Task Force, it is submitted to outside specialists for review. In some cases, the document can be presented to a panel of key opinion leaders in Europe, specialists in the relevant condition in question, for discussion and critical review. If necessary, the document is revised once more and finally approved by the Committee for Practice Guidelines and selected members of the Board of the European Society of Cardiology and subsequently published.

RECOMMENDATIONS

MAJOR RECOMMENDATIONS

Definitions for the recommendation classes (I, II, IIa, IIb) and levels of evidence (A, B, C) are given at the end of the "Major Recommendations."

General Comments

The aims of the evaluation of patients with valvular heart disease (VHD) are to diagnose, quantify, and assess the mechanism of VHD as well as its consequences. The consistency between the results of investigations and clinical findings should be checked at each step. Indications for interventions rely mainly on the comparative assessment of spontaneous prognosis and the results of intervention according to the characteristics of VHD and comorbidities.

Patient Evaluation

Diagnosis and evaluation of the severity of VHD should be based on the combined analysis of clinical findings and the results of investigations.

Clinical Evaluation

The aim of analysing case history is to assess present and past symptoms, as well as looking for associated comorbidity. The patient is questioned on her/his lifestyle to detect progressive changes in the daily activity in order to limit the subjectivity of symptom analysis, in particular, in the elderly. Questioning the patient is also important to check the quality of follow-up, the effectiveness of prophylaxis of endocarditis and, where applicable, of rheumatic fever. In patients receiving chronic anticoagulant therapy, it is necessary to assess the stability of anticoagulation and look for thrombo-embolism or bleeding.

Clinical examination plays a major role in the detection of VHD in asymptomatic patients. It is the first step in the diagnosis of VHD and the assessment of its

severity. In patients with a heart valve prosthesis, it is necessary to be aware of any change in murmur or prosthetic sounds.

An electrocardiogram (ECG) and chest x-ray are usually carried out alongside clinical examination. Besides cardiac enlargement, analysis of pulmonary vascularization on the chest x-ray is useful when interpreting dyspnoea or clinical signs of heart failure.

Echocardiography

In addition to clinical findings, echocardiography is the key technique to confirm the diagnosis of VHD, as well as to assess its severity and prognosis. It is indicated in any patient with a murmur when valve disease is suspected, the only possible exception being young patients who only have a trivial (grade 1/6) mid-systolic murmur.

The evaluation of the severity of stenotic VHD should combine the assessment of valve area and flow-dependent indices such as mean gradient and/or maximal flow velocity. Flow-dependent indices such as mean gradient or maximal flow velocity add further information and have a prognostic value.

The assessment of valvular regurgitation should combine different indices including quantitative Doppler echocardiography, such as the effective regurgitant orifice area (ERO), which is less dependent on flow conditions than colour Doppler jet size. However, all quantitative evaluations, such as the continuity equation or flow convergence, have limitations. In particular, they combine a number of measurements and are highly sensitive to errors of measurement; therefore, their use requires experience.

Thus, when assessing the severity of VHD, it is necessary to check consistency between the different echocardiographic measurements as well as with the anatomy and mechanisms of VHD. It is also necessary to check their consistency with clinical assessment. In Table 2 in the original guideline document, this is illustrated as it applies to the quantification of severe regurgitation.

Echocardiography should include a comprehensive evaluation of all valves, looking for associated valve diseases and that of the ascending aorta.

Indices of left ventricular (LV) enlargement and function are strong prognostic factors in aortic regurgitation (AR) and mitral regurgitation (MR) and, thus, play an important role in decision-making. It is also important to index LV dimensions to body surface area (BSA) to take into account patient's body size. However, the validity of indexed values is uncertain for extreme body size.

Transoesophageal echocardiography (TEE) should be considered when transthoracic examination is of suboptimal quality or when thrombosis, prosthetic dysfunction, or endocarditis is suspected. It should be performed intraoperatively to monitor the results of valve repair or complex procedures.

Three-dimensional echocardiography is a promising technique, particularly for the evaluation of valve anatomy. However, its incremental usefulness in decision-making has not been validated so far.

Fluoroscopy

Fluoroscopy can be used to assess annular or valvular calcification, as it enables calcification to be distinguished from fibrosis with a higher specificity than echocardiography. Fluoroscopy is also useful to assess the kinetics of the mobile part of a mechanical prosthesis.

Radionuclide Angiography

Radionuclide angiography provides a reproducible evaluation of LV ejection fraction (EF) in patients in sinus rhythm. This aids decision-making in asymptomatic patients with valvular regurgitation, in particular, when echocardiographic examination is of suboptimal quality.

Stress Testing

Exercise Electrocardiogram

The primary purpose of exercise testing is to unmask the objective occurrence of symptoms in patients who claim to be asymptomatic. In truly asymptomatic patients, it has an additional value for risk stratification in aortic stenosis (AS). Exercise testing will also determine the level of authorized physical activity, including participation in sports.

Exercise Echocardiography

Promising recent reports suggest that the estimation of the prognosis of VHD and indications for intervention may be refined by measuring changes in gradients or degree of regurgitation on exercise. Echocardiography performed immediately after exercise has shown to be useful to assess the prognosis of degenerative MR. However, these preliminary findings need to be confirmed before this can be recommended in practice.

Other Stress Tests

Low-dose dobutamine stress echocardiography is useful in AS with impaired LV function. The use of stress tests to detect coronary artery disease associated with severe VHD is discouraged because of their low diagnostic value.

Other Non-invasive Imaging Techniques

Computed Tomography

Preliminary data show that computed tomography (CT) scanning enables valve calcification to be accurately quantified with good reproducibility. Valve calcification is linked to the severity of VHD and provides additional prognostic

information. In expert centres, multislice CT can be useful to exclude coronary artery disease in patients who are at low risk of atherosclerosis.

Magnetic Resonance Imaging

At present, magnetic resonance imaging (MRI) is not indicated in VHD in routine clinical practice; however, most measurements usually acquired by Doppler echocardiography can also be acquired with MRI and thus MRI can be used as an alternative technique when echocardiography is not feasible. In particular, quantification of cardiac function, dimensions, and regurgitant volume is very accurate with MRI.

Biomarkers

Natriuretic peptide serum level, in particular, of the B-type, has been shown to be related to functional class and prognosis, particularly in AS and MR. However, data regarding their incremental value in risk-stratification so far remain limited.

Coronary Angiography

Coronary angiography is widely indicated to detect associated coronary artery disease when surgery is planned (see Table below). Knowledge of coronary anatomy improves risk-stratification and determines whether coronary revascularization is indicated in association with valvular surgery.

Coronary angiography can be omitted in young patients with no risk factors and in rare circumstances when its risk outweighs benefit, e.g., in acute aortic dissection, a large aortic vegetation in front of coronary ostia, or occlusive prosthetic thrombosis leading to an unstable haemodynamic condition.

Table. Indications for Coronary Angiography in Patients with Valvular Heart Disease

	Class
Before valve surgery in patients with severe VHD and any of the following:	**IC**
History of coronary artery disease Suspected myocardial ischaemia[a] LV systolic dysfunction In men aged over 40 and post-menopausal women ≥1 Cardiovascular risk factor	

Table. Indications for Coronary Angiography in Patients with Valvular Heart Disease	
	Class
When coronary artery disease is suspected to be the cause of severe MR (ischaemic MR).	**IC**

LV = left ventricle, MR = mitral regurgitation, VHD = valvular heart disease.
[a] Chest pain, abnormal non-invasive testing

Cardiac Catheterization

The measurement of pressures and cardiac output, or the performance of ventricular angiography, is restricted to situations where non-invasive evaluation is inconclusive or discordant with clinical findings. Given its potential risks, cardiac catheterization to assess haemodynamics should not be systematically associated with coronary angiography, although this remains common in current practice.

Assessment of Comorbidity

The choice of specific examinations to assess comorbidity is directed by the clinical evaluation. The most frequently encountered are peripheral atherosclerosis, renal failure, and chronic obstructive pulmonary disease.

Endocarditis Prophylaxis

Endocarditis prophylaxis should be considered in any patient with VHD and adapted to the individual patient risk.

Risk Stratification

The Euro Heart Survey has shown that, in current practice, there is general agreement between the decision to operate and the existing guidelines in asymptomatic patients. However, in patients with severe symptoms, intervention is underused for reasons that are often unjustified. This stresses the importance of the widespread use of careful risk stratification.

In the absence of evidence from randomized clinical trials, the decision to intervene in a patient with VHD relies on an individual risk-benefit analysis, suggesting that improvement of prognosis compared with natural history outweighs the risk of intervention and its potential late consequences, in particular, prosthesis-related complications.

The evaluation of the prognosis of VHD depends on the type of VHD and is derived from studies on natural history, which are frequently old and not always applicable to current presentations of VHD. Only a few contemporary studies enable spontaneous prognosis to be assessed according to patient characteristics.

Factors predicting operative mortality have been identified from large series of patients undergoing cardiac surgery or, more specifically, heart valve surgery. They are related to heart disease, the patient's age, comorbidity, and the type of surgery. The easiest way to integrate the weight of the different predictable factors is to combine them in multivariate scores, enabling operative mortality to be estimated. The Euroscore (see Table 4 in the original guideline document) is widely used in this setting. Although it has been elaborated for cardiac surgery in general, it has been validated in valvular surgery.

Aortic Regurgitation

Evaluation

Initial examination should include a detailed clinical evaluation. AR is diagnosed by the presence of a diastolic murmur. Exaggerated arterial pulsations and low diastolic pressure represent the first and main clinical signs for quantifying AR. Peripheral signs are attenuated in acute AR, which contrasts with a poor functional tolerance.

The general principles for the use of invasive and non-invasive investigations follow the recommendations made in the "General Comments" section above.

Specific issues in AR are outlined in the original guideline document.

Results of Surgery

Surgical treatment of AR is aortic valve replacement when there is no associated aortic aneurysm. When an aneurysm of the aortic root is associated, surgery also comprises replacement of the ascending aorta with re-implantation of the coronary arteries, combined with either replacement of the valve or valve-sparing techniques. In current practice, valve replacement remains the standard and the other procedures are performed in only a small percentage of patients. Supra-coronary replacement of ascending aorta can be performed when Valsalva sinuses are preserved.

Indications for Surgery

In symptomatic acute AR, urgent intervention is indicated. In chronic AR, the goals of the operation are to improve outcome, to diminish symptoms, to prevent the development of postoperative heart failure and cardiac death, and to avoid aortic complications in patients who present with aortic aneurysm.

On the basis of robust observational evidence, recommended surgical indications are as follows:

Table. Indications for Surgery in Aortic Regurgitation

	Class
Severe AR	
Symptomatic patients (dyspnoea,	**IB**

Table. Indications for Surgery in Aortic Regurgitation	
	Class
NYHA Class II, III, IV or angina)	
Asymptomatic patients with resting LVEF ≤50%	**IB**
Patients undergoing CABG or surgery of ascending aorta, or on another valve	**IC**
Asymptomatic patients with resting LVEF >50% with severe LV dilatation:	
End-diastolic dimension >70 mm or	**IIaC**
ESD >50 mm (or >25 mm/m^2 BSA)[a]	**IIaC**
Whatever the severity of AR	
Patients who have aortic root disease with maximal aortic diameter[b]	
≥45 mm for patients with Marfan's syndrome	**IC**
≥50 mm for patients with bicuspid valves	**IIaC**
≥55 mm for other patients	**IIaC**
Severity is defined from clinical and echocardiographic assessment (see text of original guideline document). In asymptomatic patients, repeated and high-quality measures are necessary before surgery. AR = aortic regurgitation, BSA = body surface area, CABG = coronary artery bypass grafting, ESD = end-systolic dimension, EF = ejection fraction, LV = left ventricular. [a] Patient's stature should be considered. Indexing is helpful. Changes in sequential measurements should be taken into account. [b] Decision should take into account the shape and thickness of ascending aorta as well as the shape of the other parts of aorta. For patients who have an indication for surgery on the aortic valve, lower thresholds can be used for combining surgery on the ascending aorta.	

Medical Therapy

Nitroprusside and inotropic agents (dopamine or dobutamine) may be used before surgery in patients with poorly tolerated acute AR to stabilize their clinical condition. In patients with chronic severe AR and heart failure, angiotensin-converting enzyme (ACE)-inhibitors are the treatment of choice when surgery is contraindicated or in cases with persistent postoperative LV dysfunction.

In asymptomatic patients with high blood pressure, the indication for anti-hypertensive treatment with vasodilators such as ACE-inhibitors or dihydropyridine calcium channel blockers is warranted.

The role of vasodilators in the asymptomatic patients without high blood pressure in order to delay surgery is unproved.

In patients with Marfan's syndrome, beta-blockers slow the progression of the aortic dilatation and should also be given after operation. In patients with severe AR, the use of beta-blockers should be very cautious because the lengthening of diastole increases the regurgitant volume. However, they can be used in patients with severe LV dysfunction. Recently, enalapril has also been used to delay aortic dilation in patients with Marfan's syndrome. Whether the same beneficial effect occurs in patients with bicuspid aortic valves is not known.

Patients with AR should be educated on endocarditis prevention and antibiotic prophylaxis.

In patients with Marfan's syndrome or in young patients with aortic root aneurysm, the family needs to be screened to detect asymptomatic cases.

Serial Testing

Patients with mild-to-moderate AR can be seen on a yearly basis and echocardiography performed every 2 years.

All patients with severe AR and normal LV function should be seen for follow-up at 6 months after their initial examination. If LV diameter and/or EF show significant changes, or they become close to the thresholds for intervention, follow-up should continue at 6 month intervals. When parameters are stable, follow-up can be yearly.

In patients with a dilated aortic root, and especially in patients with Marfan's syndrome or with bicuspid aortic valves, examination of the aorta should be performed on a yearly basis, but with closer intervals if aortic enlargement is detected.

Refer to the original guideline document for information on special patient populations.

Aortic Stenosis

Evaluation

Patient history and physical examination remain essential. Careful exploration for the presence of symptoms (exertional shortness of breath, angina, dizziness, or syncope) is critical for proper patient management and must take into account that patients may deny symptoms because they significantly reduce their activities.

The characteristic systolic murmur draws the attention and guides the further diagnostic work in the right direction. Occasionally, the murmur may, however, be faint and primary presentation may be heart failure of unknown cause. The disappearance of the second aortic sound is specific to severe AS, although not a sensitive sign.

The general principles for the use of invasive and non-invasive investigations follow the recommendations made in the "General Comments" section.

Specific issues that need to be addressed in AS are outlined in the original guideline document.

Indications for Surgery

Surgical indications are as follows:

Table. Indications for Aortic Valve Replacement in Aortic Stenosis	
	Class
Patients with severe AS and any symptoms	**IB**
Patients with severe AS undergoing coronary artery bypass surgery, surgery of the ascending aorta, or on another valve	**IC**
Asymptomatic patients with severe AS and systolic LV dysfunction (LVEF<50%) unless due to other cause	**IC**
Asymptomatic patients with severe AS and abnormal exercise test showing symptoms on exercise	**IC**
Asymptomatic patients with severe AS and abnormal exercise test showing fall in blood pressure below baseline	**IIaC**
Patients with moderate AS[a] undergoing coronary artery bypass surgery, surgery of the ascending aorta, or another valve	**IIaC**
Asymptomatic patients with severe AS and moderate-to-severe valve calcification, and a rate of peak velocity progression $\geq$0.3 m/s per year	**IIaC**
AS with low gradient (<40 mmHg) and LV dysfunction with contractile reserve	**IIaC**
Asymptomatic patients with severe AS and abnormal exercise test showing complex ventricular arrhythmias	**IIbC**
Asymptomatic patients with severe AS and excessive LV hypertrophy($\geq$15 mm) unless this is due to hypertension	**IIbC**
AS with low gradient (<40 mmHg) and LV dysfunction without contractile reserve	**IIbC**

S = aortic stenosis, EF = ejection fraction, LV = left ventricular.
[a] Moderate AS is defined as valve area 1.0 to 1.5cm^2 (0.6 cm^2/m^2 to 0.9 cm^2/m^2 BSA) or mean aortic gradient 30 to 50 mmHg in the presence of normal flow conditions. However, clinical judgment is required.

Indications for Balloon Valvuloplasty

This intervention can be considered as a bridge to surgery in haemodynamically unstable patients who are at high risk for surgery (**Recommendation class IIb, Level of evidence C**) or in patients with symptomatic severe AS who require

urgent major non-cardiac surgery (**Recommendation class IIb, Level of evidence C**). Occasionally, balloon valvuloplasty could be considered as a palliative measure in individual cases when surgery is contraindicated because of severe comorbidities.

Medical Therapy

The progression of degenerative AS is an active process sharing a number of similarities with atherosclerosis. Thus, modification of atherosclerotic risk factors must be strongly recommended following the guidelines of secondary prevention in atherosclerosis.

Although several retrospective reports have shown beneficial effects of statins and ACE-inhibitors, data are still conflicting and the only randomized trial assessing the effect of statin therapy is negative. It is, therefore, too early for treatment recommendations.

Symptomatic patients require early surgery, as no medical therapy for AS is able to delay the inevitability of surgery. However, patients who are unsuitable candidates for surgery may be treated with digitalis, diuretics, ACE-inhibitors, or angiotensin receptor blockers if they are experiencing heart failure. Beta-blockers should be avoided in these circumstances. In selected patients with pulmonary oedema, nitroprusside can be used under haemodynamic monitoring.

Co-existing hypertension should be treated; however, treatment should be carefully titrated to avoid hypotension and patients more frequently evaluated.

Maintenance of sinus rhythm is particularly important. Endocarditis prophylaxis is indicated in all patients with AS.

Serial Testing

The wide variability of the rate of progression of AS heightens the need for patients to be carefully educated about the importance of follow-up and reporting symptoms as soon as they develop. In the asymptomatic patient, stress tests should determine the recommended level of physical activity. Follow-up visits should include echocardiographic assessment since the rate of haemodynamic progression is important for management decisions. Type and interval of follow-up should be determined on the basis of the initial examination.

In cases of moderate-to-severe calcification of the valve and peak aortic jet velocity >4 m/s at initial evaluation, patients should be re-evaluated every 6 months for the occurrence of symptoms and change in exercise tolerance or in echo-parameters. If peak aortic jet velocity has increased since the last visit (>0.3 m/s per year) or if other evidence of haemodynamic progression is present, surgery should be considered. If no change has occurred and the patient remains asymptomatic, six-monthly clinical and six- to 12-monthly clinical and echocardiographic re-evaluations are recommended.

In patients who do not meet these criteria, a clinical yearly follow-up is necessary, follow-up being closer in those with borderline values. The frequency of echocardiographic examinations should be adapted to clinical findings.

Refer to the original guideline for information on special patient populations.

Mitral Regurgitation

Mitral regurgitation (MR) is now the second most frequent valve disease after AS. The treatment has been re-orientated as a result of the good results of valve repair. This section deals with organic, ischaemic, and functional MR.

Organic Mitral Regurgitation

Organic MR covers all aetiologies in which leaflet abnormality is the primary cause of the disease, in opposition to ischaemic and functional MR, in which MR is the consequence of LV disease.

Reduced prevalence of rheumatic fever and increased life span in industrialized countries have progressively changed the distribution of aetiologies. Degenerative MR is the most common aetiology in Europe, whereas ischaemic and functional MR are increasingly frequent. Endocarditis is dealt with in separate specific European Society of Cardiology (ESC) guidelines.

Evaluation

Clinical examination usually provides the first clues that MR is present and may be significant as suggested by the intensity and duration of the systolic murmur and the presence of the third sound. The general principles for the use of invasive and non-invasive investigations follow the recommendations made in the "General Comments" section.

The specific issues in MR are outlined in the original guideline document.

Indications for Intervention

Indications for surgery in severe chronic organic MR are as follows:

Table. Indications for Surgery in Severe Chronic Organic Mitral Regurgitation

	Class
Symptomatic patients with LVEF>30% and ESD <55 mm	**IB**
Asymptomatic patients with LV dysfunction (ESD >45 mm[a] and/or LVEF ≤60%)	**IC**
Asymptomatic patients with preserved LV function and atrial fibrillation or pulmonary hypertension (systolic pulmonary artery pressure >50 mmHg at rest)	**IIaC**
Patients with severe LV dysfunction (LVEF <30% and/or ESD >55 mm)[a] refractory to medical therapy with high likelihood of durable repair, and low	**IIaC**

Table. Indications for Surgery in Severe Chronic Organic Mitral Regurgitation	
	Class
comorbidity	
Asymptomatic patients with preserved LV function, high likelihood of durable repair, and low risk for surgery	**IIbB**
Patients with severe LV dysfunction (LVEF <30% and/or ESD >55 mm)[a] refractory to medical therapy with low likelihood of repair and low comorbidity	**IIbC**

Severity is based on clinical and echocardiographic assessment.
ESD = end-systolic dimension, EF = ejection fraction, LF = left ventricular, MR = mitral regurgitation.
[a] ower values can be considered for patients of small stature.

Medical Therapy

In acute MR, reduction of filling pressures can be obtained with nitrates and diuretics. Nitroprusside reduces afterload and regurgitant fraction. Inotropic agents should be added in case of hypotension.

Anticoagulant therapy, with a target international normalized ratio (INR) range between 2 and 3, should be given in patients with MR and permanent or paroxysmal AF or whenever there is a history of systemic embolism or evidence of left atrial thrombus and during the first 3 months following mitral valve repair.

In severe MR, maintenance of sinus rhythm after cardioversion is unlikely unless the MR is treated surgically. If AF occurs, heart rate should be controlled.

There is no evidence to support the use of vasodilators, including ACE-inhibitors, in chronic MR without heart failure and therefore they are not recommended in this group of patients.

On the other hand, when heart failure has developed, ACE-inhibitors have a benefit and may be used in patients with advanced MR and severe symptoms who are not suitable for surgery or when there are still residual symptoms following the operation, usually as a result of impaired LV function. Beta-blockers and spironolactone should also be considered as appropriate. Endocarditis prophylaxis is also required.

Serial Testing

Asymptomatic patients with moderate MR and preserved LV function can be clinically followed-up on a yearly basis and echocardiography should be performed every 2 years.

Asymptomatic patients with severe MR and preserved LV function should be seen every 6 months and echocardiography performed every year, the follow-up being closer if no previous evaluation is available, and in patients with borderline values, or significant changes since the last visit. These patients should be instructed to promptly report any change in functional status.

Following valve repair, as is the case after valve replacement, it is sensible to establish a baseline for ECG, x-ray, and echocardiography so that this is available for later comparison, particularly if clinical changes occur.

Ischaemic Mitral Regurgitation

Ischaemic MR is a frequent entity, which is, however, frequently overlooked in the setting of acute or chronic coronary disease. Chronic ischaemic MR is the consequence of a restriction in leaflet motion, which is due to tethering by the subvalvular apparatus in patients who have LV enlargement and/or dysfunction, in particular of the posterolateral wall.

Evaluation

Acute MR due to papillary muscle rupture should be envisaged in a patient presenting with shock during acute myocardial infarction. The murmur may even be inaudible, which stresses the importance of performing echocardiography urgently in this setting. In chronic ischaemic MR, the murmur is of low intensity, which should not lead to the conclusion that MR is trivial.

It should be remembered that ischaemic MR is a dynamic condition and its severity may vary from time to time in relation to arrhythmias, ischaemia, hypertension, or exercise. Acute pulmonary oedema may result from a large exercise-induced increase in ischaemic MR.

Echocardiographic examination is useful for establishing the diagnosis and differentiating true ischaemic MR, where valves are normal, from organic MR is patients with coronary disease.

After myocardial infarction, ischaemic MR should be routinely looked for and Doppler assessment of MR should be done. Colour flow mapping of the regurgitant jet overestimates the severity of ischaemic MR. The use of quantitative methods adds important information. In ischaemic MR, lower thresholds of severity, using quantitative methods, have been proposed (20 mm^2 for ERO and 30 mL for regurgitant volume).

Ischaemic MR is a dynamic disease, which makes it logical to think that stress testing is likely to play an important role in the evaluation. Preliminary studies have shown that quantitation of MR during exercise is feasible, provides a good appreciation of dynamic characteristics, and has prognostic importance. The prognostic value of exercise tests to predict the results of surgery has, however, to be evaluated.

TEE in the operating room should not be used to decide upon treatment of MR because, in some patients, the afterload reduction during surgery decreases the degree of MR.

Limited studies using low-dose dobutamine or positron emission tomography have explored preoperative myocardial viability as a predictor of outcome.

The assessment of coronary status is of particular importance since it completes the diagnosis and allows evaluation of the revascularization options.

Indications for Surgery

Rupture of a papillary muscle necessitates urgent surgical treatment after stabilization of the haemodynamic status, using an intra-aortic balloon pump and vasodilators. In addition to CABG, surgery consists of valve replacement in most cases.

The limited data in the field of ischaemic MR result in less evidence-based management.

Table. Indications for Surgery in Chronic Ischaemic Mitral Regurgitation

	Class
Patients with severe MR, LVEF >30% undergoing CABG	**IC**
Patients with moderate MR undergoing CABG if repair is feasible	**IIaC**
Symptomatic patients with severe MR, LVEF<30% and option for revascularization	**IIaC**
Patients with severe MR, LVEF>30%, no option for revascularization, refractory to medical therapy, and low comorbidity	**IIbC**

CABG = coronary artery bypass grafting, MR = mitral regurgitation, LV = left ventricular, EF = ejection fraction

Functional Mitral Regurgitation

In this group, mitral valves are also structurally normal and MR is secondary to the changes in LV geometry resulting from impaired LV function. It includes MR observed in cardiomyopathy and in ischaemic disease with severe LV dysfunction. Evaluation is the same as in ischaemic MR.

The main surgical technique is restrictive annuloplasty. Other techniques can be combined aiming at LV remodelling and are currently being evaluated.

The limited data available suggest that isolated mitral valve surgery in combination with LV reconstruction techniques may be considered in selected patients with severe functional MR and severely depressed LV function, including those with coronary disease, where bypass surgery is not indicated, who remain symptomatic despite optimal medical therapy, and if comorbidity is low, the aim being to avoid or postpone transplantation.

Medical therapy is the preferred treatment which should be used before considering surgical correction of the functionally regurgitant valve. ACE-inhibitors and beta-blockers, which may reduce MR by progressive inverse LV remodeling, are indicated. Nitrates and diuretics are useful for treating acute dyspnoea, secondary to any dynamic component.

LV dilation, distortion, and dyssynchrony are linked to functional MR in patients with heart failure and LV dysfunction. Thus, in patients with increased QRS

duration and intra-ventricular asynchrony, cardiac resynchronization therapy may reduce MR severity and improve LV function. Defibrillators should be used according to the appropriate recommendations.

Mitral Stenosis

Evaluation

It may be difficult to evaluate precisely the functional disability in these patients who often present with a gradual decrease in activity and may feel asymptomatic for years. Physical examination, chest x-ray, and ECG establish the diagnosis in most cases and allow for initial evaluation of consequences such as atrial fibrillation and pulmonary hypertension.

The general principles for the use of invasive and non-invasive investigations follow the recommendations made in the "General Comments" section.

Specific issues in mitral stenosis (MS) are outlined in the original guideline document.

Indications for Intervention

Type of treatment, as well as its timing, should be decided on the basis of clinical characteristics (including functional status and predictors of operative risk and of the results of percutaneous mitral commissurotomy [PMC]), valve anatomy, and local expertise and availability in the fields of PMC and surgery.

Indications for intervention are as follows:

Table Indications for Percutaneous Mitral Commissurotomy (PMC) in Mitral Stenosis with Valve Area <1.5 cm^2	
	Class
Symptomatic patients with favourable characteristics[a] for PMC	**IB**
Symptomatic patients with contraindication or high risk for surgery	**IC**
As initial treatment in symptomatic patients with unfavourable anatomy but otherwise favourable clinical characteristics[a]	**IIaC**
Asymptomatic patients with favourable characteristics[a] and high thrombo-embolic risk or high risk of haemodynamic decompensation:	
Previous history of embolism	**IIaC**
Dense spontaneous contrast in the left atrium	**IIaC**
Recent or paroxysmal atrial fibrillation	**IIaC**
Systolic pulmonary pressure >50 mmHg at rest	**IIaC**
Need for major non-cardiac surgery	**IIaC**
Desire of pregnancy	**IIaC**
PMC = percutaneous mitral commissurotomy [a] Favourable characteristics for PMC can be defined by the absence of several of the following: • *Clinical characteristics*: old age, history of comissurotomy, NYHA class IV, atrial fibrillation,	

Table Indications for Percutaneous Mitral Commissurotomy (PMC) in Mitral Stenosis with Valve Area <1.5 cm^2	
	Class
severe pulmonary hypertension • *Anatomic characteristics*: echo score >8, Cormier score 3 (Calcification of mitral valve of any extent, as assessed by fluoroscopy), very small mitral valve area, severe tricuspid regurgitation.	

Medical Therapy

Diuretics or long-acting nitrates transiently ameliorate dyspnoea. Beta-blockers or heart-rate regulating calcium channel blockers are useful to slow the heart rate and can greatly improve exercise tolerance by prolonging diastole and hence the time available for LV filling via the stenosed valve. Anticoagulant therapy with a target international normalized ratio (INR) in the upper half of the range 2-3 is indicated in patients with either permanent or paroxysmal AF. In patients with sinus rhythm, anticoagulation is mandatory when there has been prior embolism or a thrombus is present in the left atrium (**Recommendation class I, Level of evidence C**), and recommended when TEE shows dense spontaneous echo contrast or in patients who have an enlarged left atrium (diameter >50 mm) (**Recommendation class IIa, Level of evidence C**).

Cardioversion is not indicated before intervention in patients with severe MS, as it does not usually restore sinus rhythm in the medium or long term. If atrial fibrillation is of recent onset and the left atrium only moderately enlarged, cardioversion should be performed soon after successful intervention. Sinus rhythm can be maintained with the use of class IC or III anti-arrhythmic drugs.

Infective endocarditis prophylaxis is indicated. In countries with a high prevalence of rheumatic disease, rheumatic fever prophylaxis should be given to young patients and be continued after conservative intervention until adult age.

Serial Testing

Asymptomatic patients with clinically significant MS who have not undergone intervention should be followed up yearly by means of clinical and echocardiographic examinations and at longer intervals in cases with stenosis of a lesser degree.

Management of patients after successful PMC is similar to that of asymptomatic patients. When PMC is not successful and symptoms persist, surgery should be considered early unless there are definite contraindications. See the original guideline document for information.

Tricuspid Disease

Tricuspid Stenosis

Tricuspid stenosis (TS), which is almost exclusively of rheumatic origin, is rarely observed in developed countries, although it is still seen in developing countries.

Detection requires careful evaluation, as it is almost always associated with left-sided valve lesions that dominate the presentation.

Evaluation

Clinical signs are often masked by those of the associated valvular lesions, especially MS. Echocardiography provides the most useful information. TS is often overlooked and requires careful evaluation. The pressure half-time method has never been validated for the tricuspid valve, and the continuity equation is rarely applicable because of the frequency with which associated regurgitation is present. Planimetry of the valve area is usually impossible unless three-dimensional echocardiography is used. No generally accepted grading of TS severity exists. A mean gradient >5 mmHg is considered indicative of clinically significant TS. Echocardiography should also examine the presence of commissural fusion, the anatomy of the valve, and its subvalvular apparatus, which are the most important determinants of reparability and the degree of concomitant regurgitation.

Indications for Intervention

Intervention on the tricuspid valve is usually carried out at the time of intervention on the other valves in patients who are symptomatic despite medical therapy. Conservative surgery or valve replacement, according to anatomy and surgical expertise in valve repair, is preferred to balloon commissurotomy, which can only be considered as a first approach in the rare cases of isolated TS.

Table. Indications for Intervention in Tricuspid Valve Disease

	Class
Severe TR in a patient undergoing left-sided valve surgery	**IC**
Severe primary TR and symptoms despite medical therapy without severe right ventricular dysfunction	**IC**
Severe TS (± TR), with symptoms despite medical therapy[a]	**IC**
Severe TS (± TR) in a patient undergoing left-sided valve intervention[a]	**IC**
Moderate organic TR in a patient undergoing left-sided valve surgery	**IIaC**
Moderate secondary TR with dilated annulus (>40 mm) in a patient undergoing left-sided valve surgery	**IIaC**
Severe TR and symptoms, after left-sided valve surgery, in the absence of left-sided myocardial, valve, or right ventricular dysfunction and without severe pulmonary hypertension(systolic pulmonary artery pressure >60 mmHg)	**IIaC**
Severe isolated TR with mild or no symptoms and progressive dilation or deterioration of right ventricular function	**IIbC**

TR = tricuspid regurgitation, TS = tricuspid stenosis.
[a] Percutaneous technique can be attempted as a first approach if TS is isolated.

Medical Therapy

In the presence of heart failure, diuretics are useful but of limited efficacy. Endocarditis prophylaxis should be given as appropriate.

Tricuspid Regurgitation

Trivial tricuspid regurgitation (TR) is frequently detected by echocardiography in normal subjects. Pathological TR is more often functional rather than due to a primary valve lesion. Functional TR is due to annular dilatation and secondary to right ventricular pressure and/or volume overload. Pressure overload is most often caused by pulmonary hypertension resulting from left-sided heart disease or, more rarely, cor pulmonale, idiopathic pulmonary artery hypertension, and right ventricular volume overload possibly relating to atrial septal defects or intrinsic disease of the right ventricle.

Evaluation

Predominant symptoms are those of associated diseases, and even severe TR may be well tolerated for a long period of time. Although they are load dependent, clinical signs of right heart failure are of value in evaluating the severity of TR.

Echocardiography is the ideal technique to evaluate TR.

When available, MRI may provide additional useful information on the size and function of the right ventricle, which is difficult to evaluate using other imaging techniques.

Indications for Surgery

The timing of surgical intervention and the appropriate technique remain controversial mostly due to the limited data available and their heterogeneous nature (see Table above).

As general principles, if technically possible, conservative surgery is preferable to valve replacement, and surgery should be carried out early enough to avoid irreversible right ventricular dysfunction.

Medical Therapy

Diuretics improve signs of congestion. Specific therapy of the underlying disease is warranted.

Combined and Multiple Valve Diseases

The data on mixed and multiple valve diseases are lacking and do not allow for evidence-based recommendations. In addition, the large number of combinations possible leads to the necessity of individualized decisions in this domain.

Significant stenosis and regurgitation can be found on the same valve. Such combined VHDs are encountered in rheumatic valve disease and, less frequently, in degenerative valve disease. When stenosis or regurgitation is largely predominant, the management follows the recommendations concerning the predominant VHD. When the severity of both stenosis and regurgitation is balanced, indications for interventions should be based on how well the patient tolerates the combined VHD rather than indices of severity of stenosis or

regurgitation. Intervention can be considered when a non-severe stenosis is combined with a non-severe regurgitation in patients who have symptoms or in whom it is clear the combined lesion is leading to LV impairment. Intervention is nearly always prosthetic valve replacement in this setting.

Disease of multiple valves may be encountered in several conditions but particularly rheumatic heart disease. Besides the separate assessment of each separate valve lesion, it is necessary to take into account the interaction between the different valve lesions. As an illustration, associated MS may lead to underestimation of the severity of AS, since decreased stroke volume due to MS lowers the flow across the aortic valve and hence the aortic gradient. This underlines the need to combine different measurements, including assessment of valve areas, if possible using methods that are less dependent on loading conditions, such as planimetry. Associated MR and AR can be encountered, in particular, in Marfan's syndrome. In these patients, besides severity, the assessment of valve anatomy is of importance to evaluate the possibility of conservative surgery on each valve.

Indications for intervention are based on global assessment of the consequences of the different valve lesions, i.e., symptoms or consequences on LV dimensions and function. In addition, the decision to intervene on multiple valves should take into account the extra surgical risk of combined procedures. The choice of surgical technique should take into account the presence of the other VHD. For example, the desire to repair one valve may be decreased if prosthetic valve replacement is needed on another valve. The management of other specific associations of VHD is detailed in the individual sections.

Prosthetic Valves

Patients who have undergone previous valve surgery represent an important proportion of patients with VHD, accounting for 28% of all patients with VHD in the Euro Heart Survey. The extent of prosthesis-related complications in patient outcome after surgery emphasizes the importance of optimizing the choice of the valve substitute as well as the subsequent management of patients with prosthetic valves.

Choice of Prosthetic Valve

There is no perfect valve substitute. All involve some compromise and all introduce new disease processes, whether they are mechanical or biological. The latter include xenografts, homografts, and autografts. Autografts and homografts in the aortic position provide the best effective orifice area (EOA). Stentless bioprostheses provide better EOA than stented bioprostheses, which are relatively stenotic in the small sizes (annulus size $\leq$21 mm). Modern mechanical valves provide better haemodynamic performance than stented bioprotheses.

All mechanical valves require long-term anticoagulation. Biological valves are less thrombogenic and do not require long-term anticoagulation unless there are other indications, e.g., persistent atrial fibrillation. However, all are subject to structural valve deterioration (SVD) over time.

In practice, the choice is between mechanical prosthesis and bioprosthesis in most patients. Rather than setting arbitrary age limits, prosthesis choice should be individualized and discussed in detail with the patient, taking into account the following factors:

Table. Choice of the Prosthesis: In Favour of Mechanical Prosthesis[a]	
	Class
Desire of the informed patient and absence of contraindication for long-term anticoagulation	**IC**
Patients at risk of accelerated SVD[b]	**IC**
Patient already on anticoagulation because of other mechanical prosthesis	**IC**
Patients already on anticoagulation because at high risk for thrombo-embolism[c]	**IIaC**
Age <65 to 70 and long life expectancy[d]	**IIaC**
Patients for whom future redo valve surgery would be at high risk (due to LV dysfunction, previous CABG, multiple valve prosthesis)	**IIaC**

CABG = coronary artery bypass grafting, LV = left ventricular, SVD = structural valve deterioration.
[a] The decision is based on the integration of several of the factors given in the table.
[b] Young age, hyperparathyroidism.
[c] Risk factors for thrombo-embolism; severe LV dysfunction, atrial fibrillation, previous thrombo-embolism, hypercoagulable state.
[d]According to age, gender, the presence of comorbidity, and country-specific life expectancy.

Table. Choice of the Prosthesis: In Favour of Bioprosthesis[a]	
	Class
Desire of the informed patient	**IC**
Unavailability of good-quality anticoagulation (contraindication or high risk, unwillingness, compliance problems, lifestyle, occupation)	**IC**
Re-operation for mechanical valve thrombosis in a patient with proven poor anticoagulant control	**IC**
Patient for whom future redo valve surgery would be at low risk	**IIaC**
Limited life expectancy[b], severe comorbidity, or age >65 to 70	**IIaC**
Young woman contemplating pregnancy	**IIbC**

[a] The decision is based on the integration of several of the factors given in the table.
[b] According to age, gender, the presence of comorbidity, and country-specific life expectancy.

Management after Valve Replacement

Thrombo-embolism and anticoagulant-related bleeding together account for ~75% of complications experienced by prosthetic valve recipients and most space is therefore devoted to this topic. Endocarditis prophylaxis and management of prosthetic valve endocarditis are detailed in separate ESC Guidelines devoted to endocarditis. A more comprehensive review of management after valve surgery is available in a previous Special ESC article.

Baseline Assessment and Modalities of Follow-up

A complete baseline assessment should be ideally performed 6 to 12 weeks after surgery. If for practical reasons this outpatient evaluation cannot be organized, it could be done at the end of the postoperative stay. This will include clinical assessment, chest x-ray, ECG, transthoracic echocardiography, and blood testing. This reference assessment is of utmost importance to interpret subsequent changes in murmur, prosthetic sounds, as well as ventricular function and transprosthetic gradients as assessed by Doppler echocardiography. This postoperative visit is also useful to improve patient education on endocarditis prophylaxis and, if needed, on anticoagulant therapy, as well as emphasizing that new symptoms should be reported as soon as they occur.

All patients who have undergone valve surgery require lifelong follow-up by a cardiologist in order to detect early deterioration in prosthetic function or ventricular function, or progression of disease in a further heart valve. Clinical assessment should be performed yearly or as soon as possible if new cardiac symptoms occur. Transthoracic echocardiography should be performed if any new symptoms occur after valve replacement or if complications are suspected. Yearly echocardiographic examination is recommended after the fifth year in patients with bioprosthesis. Transprosthetic gradients during follow-up are best interpreted in comparison with the baseline values in the same patient, rather than in comparison with theoretical values for a given prosthesis, which lack reliability. TEE should be considered if transthoracic echocardiography is of poor quality and in all cases of suspected prosthetic dysfunction or endocarditis. Cinefluoroscopy can provide useful additional information if valve thrombus or pannus is suspected.

Antithrombotic Management

General Management

Antithrombotic management should encompass the effective management of risk factors for thrombo-embolism in addition to the prescription of antithrombotic drugs.

Oral anticoagulation is recommended for the following situations:

- Lifelong for all patients with mechanical valves.
- Lifelong for patients with bioprostheses who have other indications for anticoagulation, e.g., atrial fibrillation, or with a lesser degree of evidence, e.g., heart failure, impaired LV function (EF <30%)
- For the first 3 months after insertion in all patients with bioprostheses with a target INR of 2.5. However, there is widespread use of aspirin (low dose: 75 to 100 mg) as an alternative to anticoagulation for the first 3 months, but there are no randomized studies to support the safety of this strategy.

Although there is no consensus regarding the initiation of anticoagulant therapy immediately after valve replacement, oral anticoagulation should be started during the first postoperative days. Intravenous heparin enables effective anticoagulation to be obtained before the INR rises.

The first postoperative month is a particularly high-risk period for thrombo-embolism, and anticoagulation should avoid being lower than the target value

during this period. In addition, anticoagulation should be monitored more frequently during this period.

Target INR

The choice of optimum INR should take into account patient risk factors and the thrombogenicity of the prosthesis as determined by reported valve thrombosis rates for that prosthesis in relation to specific INR levels.

Table. Target International Normalized Ratio for Mechanical Prostheses

Prosthesis thrombogenicity[a]	Patient-related risk factors[b]	
	No risk factor	≥1 risk factor
Low	2.5	3.0
Medium	3.0	3.5
High	3.5	4.0

LVEF = left ventricular ejection fraction, MS = mitral stenosis.
[a] Prosthesis thrombogenicity: Low = Carbomedics (aortic position), Medtronic Hall, St Jude Medical (without Silzone); Medium = Bjork-Shirley, other bileaflet valves; High = Lillehei-Kaster, Omniscience, Starr-Edwards.
[b] Patient-related risk factors: mitral, tricuspid, or pulmonary valve replacement; previous thrombo-embolism; atrial fibrillation; left atrial diameter >50mm; left atrial dense spontaneous contrast; MS of any degree
LVEF <35%; hypercoagulable state.

Antiplatelet Drugs

In determining whether an antiplatelet agent should be added to anticoagulation in patients with prosthetic valves, it is important to distinguish between the possible benefits in vascular disease and those specific to prosthetic valves.

Indications for the addition of an antiplatelet agent to anticoagulation include concomitant arterial disease, in particular, coronary disease and other significant atherosclerotic disease. Antiplatelet agents can also be added after recurrent or one definite embolic episode with adequate INR. Addition of antiplatelet agents should be associated with a full investigation and treatment of identified risk factors and optimization of anticoagulation management (**Recommendation class IIa, Level of evidence C**).

Addition of aspirin and clopidogrel is necessary following intracoronary stenting but increases bleeding risk. The use of drug-eluting stents should be restricted in patients with mechanical prostheses to shorten as much as possible the use of triple antithrombotic therapy. During this period, weekly monitoring of INR is advised and any over-anticoagulation should be avoided.

Finally, there is no evidence to support the long-term use of antiplatelet agents in patients with bioprosthesis who do not have an indication other than the presence of the bioprosthesis itself.

Interruption of Anticoagulant Therapy

Although most instances of short-term anticoagulation interruption do not lead to thrombo-embolism or valve thrombosis, the corollary is that most cases of valve thrombosis occur following a period of anticoagulation interruption for bleeding or another operative procedure. Anticoagulation management during subsequent non-cardiac surgery therefore requires very careful management on the basis of risk assessment. Besides prosthesis- and patient-related prothrombotic factors (see Table above "Target international normalized ratio for mechanical prostheses"), surgery for malignant disease or an infective process carries a particular risk, due to the hypercoagulability associated with these conditions. For very high-risk patients, anticoagulation interruption should be avoided if at all possible. Many minor surgical procedures (including dental extraction) and those where bleeding is easily controlled do not require anticoagulation interruption. The INR should be lowered to a target of 2.0. (**Recommendation class I, Level of evidence B**).

For major surgical procedures, in which anticoagulant interruption is considered essential (INR <1.5), patients should be admitted to hospital in advance and transferred to intravenous unfractionated heparin (**Recommendation class IIa, Level of evidence C**). Heparin is stopped 6 h before surgery and resumed 6 to 12 h after. Low molecular weight heparin (LMWH) can be given subcutaneously as an alternative preoperative preparation for surgery (**Recommendation class IIb, Level of evidence C**). However, despite their wide use and the positive results of observational studies, the safety of LMWHs in this situation has not been widely established and their efficacy has not been proved by controlled studies, particularly in patients at high risk of valve thrombosis. When LMWHs are used, they should be administered twice a day, using therapeutic rather than prophylactic doses, adapted to body weight and if possible according to monitoring of anti-Xa activity. LMWHs are contraindicated in case of renal failure.

Despite the low level of evidence for both strategies, the committee favours the use of unfractionated intravenous heparin.

Effective anticoagulation should be resumed as soon as possible after the surgical procedure and maintained until the INR is once again in the therapeutic range.

If required, after a careful risk-benefit assessment, combined aspirin therapy should be discontinued 1 week before a non-cardiac procedure.

Oral anticoagulation can be continued at modified doses in the majority of patients who undergo cardiac catheterization. Percutaneous arterial puncture is safe with an INR <2.0. If a higher target INR is needed, radial approach may be recommended if the appropriate expertise is available. In the rare patients who require transseptal catheterization, direct LV puncture, or pericardiocentesis, the INR should be <1.2 and bridging anticoagulation is needed as described previously.

Management of Valve Thrombosis

Obstructive valve thrombosis should be suspected promptly in any patient with any type of prosthetic valve who presents with a recent increase in shortness of breath or embolic event. Suspicion should be higher if there has been recent inadequate anticoagulation or a cause for increased coagulability (e.g.,

dehydration, infection). The diagnosis should be confirmed by transthoracic echocardiography and/or TEE or cinefluoroscopy.

The analysis of risk and benefits of fibrinolysis should be adapted to patient characteristics and local resources.

Indications for surgery or antithrombotic therapy are as follows (see Figure 5 in the original guideline document):

Urgent or emergency valve replacement is the treatment of choice for obstructive thrombosis in critically ill patients without serious comorbidity (**Recommendation class I, Level of evidence C**). If the thrombogenicity of the prosthesis is an important factor, it should be replaced with a less thrombogenic prosthesis.

Fibrinolysis should be considered in:

- Critically ill patients unlikely to survive surgery because of comorbidities or severely impaired cardiac function prior to developing valve thrombosis.
- Situations in which surgery is not immediately available and the patient cannot be transferred.
- Thrombosis of tricuspid or pulmonary valve replacements, because of the higher success rate and low incidence of embolism.

Fibrinolysis is less likely to be successful in mitral prostheses, in chronic thrombosis, or in the presence of pannus, which can be difficult to distinguish from thrombus.

Management of left-sided non-obstructive prosthetic thrombosis is shown in Figure 6 in the original guideline document.

Non-obstructive prosthetic thrombosis is diagnosed using TEE performed after an embolic event, or systematically following mitral valve replacement with a mechanical prosthesis. The management depends mainly on the occurrence of a thrombo-embolic event and the size of the thrombus. Close monitoring by echocardiography and/or cinefluoroscopy is mandatory. The prognosis is favourable with medical therapy in most cases of small thrombus (<10 mm). A good response with gradual resolution of the thrombus obviates the need for either surgery or fibrinolysis. Conversely, surgery is recommended for large ($\geq$10 mm) non-obstructive prosthetic thrombus complicated by embolism (**Recommendation class IIa, Level of evidence C**) or which persists despite optimal anticoagulation. Fibrinolysis may be considered as an alternative if surgery is at high risk. However, the use of fibrinolysis for non-obstructive prosthetic thrombosis raises serious concerns regarding the risk of bleeding and thrombo-embolism and should therefore be very limited.

Management of Thrombo-embolism

Thorough investigation of each episode of thrombo-embolism is therefore essential (including cardiac and non-cardiac imaging when appropriate) to allow

for appropriate management (see Figure 6 in the original guideline document), rather than simply increasing the target INR or adding an antiplatelet agent.

Prevention of further thrombo-embolic events involves:

- Treatment or reversal of remediable risk factors such as AF, hypertension, hypercholesterolaemia, diabetes, smoking, chronic infection, and prothrombotic blood test abnormalities.
- Optimization of anticoagulation control, if possible with patient self-management, on the basis that better control is more effective than simply increasing the target INR. This should be discussed with the neurologist in case of recent stroke.
- Aspirin should be added, if it was not prescribed before, after a careful analysis of the risk-benefit ratio. Aspirin should be prescribed in a low-dose formulation ($\leq$100 mg daily) and any over-anticoagulation should be avoided.

Management of Haemolysis and Paravalvular Leak

Blood tests for haemolysis should be part of routine follow-up. Haptoglobin measurement is too sensitive and lactate dehydrogenase, although non-specific, is better related to the severity of haemolysis. The diagnosis of haemolytic anaemia requires TEE to detect a paravalvular leak (PVL). Only limited data are available regarding therapeutic options. There is a consensus to recommend reoperation if PVL is related to endocarditis or if PVL causes haemolysis needing repeated blood transfusions or leading to severe symptoms (**Recommendation class I, Level of evidence C**). In patients with haemolytic anaemia and PVL, where surgery is contraindicated, or those unwilling to undergo re-operation, medical therapy includes iron supplementation, beta-blockers, and erythropoietin if haemolysis is severe. Percutaneous closure of PVL has only been the subject of isolated case reports and could not be considered so far as a validated alternative to surgery.

Management of Bioprosthetic Failure

SVD occurs in all bioprostheses and homografts if they remain in situ long enough. After the first 5 years from implantation, yearly echocardiography is required to detect early signs of SVD: leaflet stiffening, calcification, reduced EOA, and/or regurgitation. Auscultatory and echocardiographic findings should be carefully compared with previous examinations in the same patient. Reoperation is advised in symptomatic patients with significant prosthetic dysfunction (significant increase in trans-prosthetic gradient or severe regurgitation) (**Recommendation class I, Level of evidence C**) and in asymptomatic patients with any significant prosthetic dysfunction, if they are at low risk for reoperation (**Recommendation class IIa, Level of evidence C**). Prophylactic replacement of a bioprosthesis implanted >10 years ago, without structural deterioration, could be considered during an intervention on another valve or coronary artery.

The decision to reoperate should take into account the risk of reoperation, which increases with older age, high functional class, LV dysfunction, comorbidities, and, above all, the emergency situation. This underlines the need for careful follow-up to allow for reoperation at an early stage, in particular, in patients who are at low risk for reoperation.

Percutaneous balloon interventions should be avoided in the treatment of stenotic left-sided bioprostheses and have a limited short-term efficacy in right-sided prosthetic valves.

Heart Failure

Heart failure after valve surgery should lead to a search for prosthetic-related complications, deterioration of repair, LV dysfunction (in particular after correction of regurgitation), or progression of another valve disease. Non-valvular-related causes such as coronary disease, hypertension, or sustained arrhythmias should also be considered.

The management of patients with persistent LV systolic dysfunction should follow the guidelines on the management of chronic heart failure.

Management During Non-cardiac Surgery

There is a significant risk of cardiovascular morbidity and mortality in patients with VHD undergoing non-cardiac surgery, especially in patients with severe AS, which is the most common type of valve disease seen in Europe and it is particularly common in the elderly.

The present recommendations arise from extrapolation from studies concerning cardiovascular risk in other instances, personal experience, and clinical judgement.

Clinical-Predictors of Increased Perioperative Cardiovascular risk

The major predictors of cardiovascular risk during non-cardiac surgery are unstable coronary syndromes, decompensated heart failure, significant arrhythmias (including high-grade atrio-ventricular block, ventricular arrhythmias, or supraventricular arrhythmias with uncontrolled ventricular rate), and severe valvular disease.

Among patients with valvular disease, risk assessment should incorporate symptomatic status, presence or not of arrhythmias, severity of the valvular lesion, LV function, and level of pulmonary pressure and comorbidities, including ischaemic heart disease.

Cardiovascular risk can also be stratified according to the different non-cardiac surgical procedures.

Preoperative Clinical Evaluation

Before non-cardiac surgery, severe VHD should be identified and the clinical status of the patient carefully evaluated.

The presence of symptoms, that is, dyspnoea, angina, syncope, or heart failure, as well as the presence of arrhythmias, like atrial fibrillation, should be recorded. Physical examination and the ECG should focus on identification of VHD. In patients with a murmur, an echocardiographic study should be done to rule out

the diagnosis of significant valve disease. This is particularly important in aged patients, because a mild systolic murmur can be the only physical sign of significant AS.

The severity of the valve lesion, ventricular function, and pulmonary pressure should be carefully evaluated by echocardiography before surgery.

Each case should be individualized and agreement reached after a full discussion with cardiologists, anaesthesiologists, ideally with a particular skill in cardiology, and surgeons.

Specific Valve Lesions

Aortic Stenosis

Several studies have clearly shown that severe AS (aortic valve area <1 cm^2 or 0.6 cm^2/m^2 BSA) increases the risk of non-cardiac surgery, and among patients with valve disease undergoing non-cardiac surgery, those with significant AS have the highest risk.

Recommendations for management are as follows:

In patients with significant AS who need urgent non-cardiac surgery, surgical procedures should be performed under careful haemodynamic monitoring.

When elective non-cardiac surgery is needed in a patient with AS, the risk of cardiac complications during surgery should be balanced with the risk and benefits of having the valve replaced before non-cardiac surgery. The severity of the valvular lesion and the presence of clinical symptoms as well as the risk and the urgency of non-cardiac surgery itself should be considered. It is also important to re-evaluate whether non-cardiac surgery is essential. A decision algorithm is proposed for patients with significant AS facing elective non-cardiac surgery (see Figure 7 in the original guideline document).

In asymptomatic patients with severe AS, a non-cardiac procedure of low or moderate risk can be performed safely. If high-risk non-cardiac surgery is needed, the patient should be carefully evaluated for aortic valve replacement before non-cardiac surgery including coronary angiography to rule out coexistent coronary artery disease. Factors influencing the preference for valve replacement performed before non-cardiac surgery would be the degree of severity of AS, the likelihood of early symptom development (high degree of valve calcification or abnormal exercise test), as well as the overall status of the patient (low comorbidity and long-life expectancy). In these patients, a bioprosthesis is the preferred valve substitute, in order to avoid anticoagulation problems during the subsequent non-cardiac surgery.

In asymptomatic patients who are poor candidates for valve replacement because of severe comorbidities as assessed by a high Euroscore or poor life expectancy, non-cardiac surgery should be carefully discussed and, if really needed, performed under strict haemodynamic monitoring.

In symptomatic patients with severe AS facing non-cardiac surgery, valve replacement should always be considered even before non-cardiac surgery at low-to-moderate risk. If valve replacement is contraindicated, non-cardiac surgery should be performed only if absolutely necessary. Although its practice has not been rigorously evaluated, percutaneous aortic valvuloplasty to create a time window of reduced cardiac risk during which the non-cardiac surgery can be performed has been considered and could have a role depending on local expertise.

Mitral Stenosis

In non-significant MS (valve area >1.5 cm^2), non-cardiac surgical procedures can be performed at low risk.

In asymptomatic patients with significant MS and a systolic pulmonary artery pressure <50 mmHg, non-cardiac surgery can also be performed at low risk, although it should be remembered that the onset of atrial fibrillation may produce a sharp deterioration.

In symptomatic patients or in patients with systolic pulmonary artery pressure >50 mmHg, correction of MS, by means of PMC whenever possible, should be attempted before non-cardiac surgery.

This recommendation is stronger before high-risk non-cardiac procedures. If surgery, in particular, valve replacement, is needed, the decision to proceed before non-cardiac surgery should be taken with caution and based on strict individual considerations.

Aortic Regurgitation and Mitral Regurgitation

In non-significant AR or MR, non-cardiac procedures can be performed at low risk.

In asymptomatic patients with preserved LV function and severe MR or AR, non-cardiac surgery can be performed at low risk.

In symptomatic patients or in patients with depressed LV function (EF <30%), non-cardiac surgery should be performed only if strictly needed. The medical therapy of heart failure should be optimized before surgery and vasodilators are particularly useful in this context.

Prosthetic Valves

In patients with prosthetic valves, valvular disease has already been corrected and non-cardiac surgery can be safely performed from the haemodynamic point of view, providing that there are no symptoms or signs of prosthetic dysfunction and recent echocardiographic assessment has been satisfactory. However, there is a high risk, mostly related to the changes in anticoagulation regimen, in patients with mechanical valves. Thus, the management of anticoagulation is of utmost importance in these circumstances (see Interruption of anticoagulant therapy section).

Endocarditis Prophylaxis

In valve disease patients, all surgical procedures, even minor, require scrupulous asepsis and avoidance of wound haematoma formation.

Antibiotic prophylaxis should be prescribed for those patients undergoing non-cardiac procedures at high bacteremic risk.

Perioperative Monitoring

Valvular patients submitted to moderate or high-risk non-surgical procedures need particular perioperative care, especially ensuring that systemic hypotension or volume depletion or overload is avoided. Particular attention should be paid to avoid hypotension in patients with AS.

In patients with moderate-to-severe AS or MS, beta-blockers or amiodarone can be used prophylactically in order to maintain sinus rhythm in the postoperative period. Whether the beneficial role of beta-blockers on cardiovascular mortality before major vascular surgery applies to valvular patients is not known.

It is prudent to electively admit such patients to intensive care postoperatively even if they appear to be doing well.

Management during Pregnancy

Haemodynamic changes that normally occur during pregnancy may worsen tolerance of underlying heart disease. Native VHD is the most frequently acquired heart disease encountered during pregnancy even in developed countries. Certain native VHDs carry a poor prognosis for the mother and foetus. In patients with a valve prosthesis, the modalities of anticoagulant therapy are problematic.

Evaluation of the Pregnant Patient with Heart Valve Disease

Ideally, valve disease should be evaluated before pregnancy and treated if necessary. Although dyspnoea may be difficult to interpret in pregnant women, its occurrence after the first trimester should lead to suspicion of underlying heart disease. In women with mechanical valve prostheses, it is necessary to assess the effective adherence to anticoagulant therapy and to check for previous complications. Cardiac auscultation during pregnancy is mandatory to detect native valve disease or prosthesis dysfunction.

Echocardiographic examination should be performed in any pregnant patient presenting with a more than trivial heart murmur, dyspnoea, or who has a prosthetic valve. Valve stenosis should be quantified using the measurement of valve area. Gradients are modified because of the increase in cardiac output and are not reliable markers of the severity of stenosis; however, they have a prognostic value. Quantitation of regurgitation should combine different measurements and take into account loading conditions. According to the type of valve disease, echocardiographic examination should also assess mitral valve anatomy or size of the ascending aorta. The assessment of LV dimensions and EF,

as well as systolic pulmonary artery pressure, indicates the tolerance of the valvular disease.

The use of chest x-rays should be limited and, when absolutely required, accompanied by appropriate shielding of the abdomen. CT is contraindicated because of the radiation dose, but MRI can be performed during pregnancy. The use of cardiac catheterization is restricted to the performance of interventional procedures an again abdominal shielding should be used.

Treatment

All strategies should be discussed and approved between obstetricians, cardiologist, and the patient and her family.

Table. Recommendations on the Management of Pregnant Women with Valvular Heart Disease

	Class
Patients with severe stenotic heart valve disease should be treated before pregnancy, if possible using percutaneous techniques in MS	**IC**
Echocardiographic examination should be performed in any pregnant patient with a murmur or unexplained dyspnoea	**IC**
Patients with Marfan's syndrome and aortic diameter >40 mm should be treated before pregnancy	**IC**
Medical therapy is favoured in most patients with regurgitant heart valve disease, even in symptomatic patients	**IC**
Surgery under extracorporeal circulation should be performed during pregnancy only in situations that threaten the mother's life and are not amenable to percutaneous treatment.	**IC**
Vaginal delivery can be performed safely in patients with heart valve disease who are in stable haemodynamic condition.	**IC**
Warfarin is the favoured anticoagulant therapy during the second and third trimesters until the 36th week[a]	**IC**
Close monitoring of anticoagulation is advised when unfractionated heparin used.	**IC**
PMC should be considered in pregnant patients who have severe symptoms or pulmonary artery pressure >50 mmHg owing to MS despite medical therapy	**IIaC**
Warfarin is favoured during the first trimester if dose is $\leq$5 mg/24 h, after patient information	**IIaC**

MS = mitral stenosis, PMC = percutaneous mitral commissurotomy.
[a]Data are lacking on other vitamin K antagonists.

Definitions:

Classes of Recommendations

Class I: Evidence and/or general agreement that a given treatment or procedure is beneficial, useful, and effective

Class II: Conflicting evidence and/or a divergence of opinion about the usefulness/efficacy of a given treatment or procedure

Class IIa: Weight of evidence/opinion is in favour of usefulness/efficacy

Class IIb: Usefulness/efficacy is less well established by evidence/opinion

Levels of Evidence

Level of Evidence A: Data derived from multiple randomized clinical trials or meta-analyses

Level of Evidence B: Data derived from a single randomized clinical trial or large non-randomized studies

Level of Evidence C: Consensus of opinion of the experts and/or small studies, retrospective studies, registries

CLINICAL ALGORITHM(S)

Algorithms are provided in the original guideline document for the following:

- Management of aortic regurgitation
- Management of severe aortic stenosis
- Management of severe chronic organic mitral regurgitation
- Management of severe mitral stenosis
- Management of left-sided obstructive prosthetic thrombosis
- Management of left-sided non-obstructive prosthetic thrombosis
- Management of severe aortic stenosis and elective non-cardiac surgery

EVIDENCE SUPPORTING THE RECOMMENDATIONS

TYPE OF EVIDENCE SUPPORTING THE RECOMMENDATIONS

The type of supporting evidence is identified and graded for selected recommendations (see "Major Recommendations" section).

BENEFITS/HARMS OF IMPLEMENTING THE GUIDELINE RECOMMENDATIONS

POTENTIAL BENEFITS

Improved management strategies for the individual patient suffering from valvular heart disease, taking into account the impact on outcome and also the risk-benefit ratio of a particular diagnostic or therapeutic procedure

POTENTIAL HARMS

- Risks of valvular surgery, including perioperative mortality and postoperative complications (e.g., thromboses)
- Bleeding complications associated with anticoagulant therapy
- Hazards to the foetus of medical therapy or surgery during pregnancy

CONTRAINDICATIONS

CONTRAINDICATIONS

- Exercise testing is contraindicated in symptomatic patients with aortic stenosis (AS) but is useful for unmasking symptoms and in the risk stratification of asymptomatic patients with severe AS.
- Low-molecular-weight heparins are contraindicated in cases of renal failure.
- Vitamin K antagonists are contraindicated during labour and delivery because of risk of cerebral bleeding in the foetus.
- Computed tomography is contraindicated during pregnancy because of danger of radiation.
- Beta-agonist agents are contraindicated during pregnancy.
- Bioprostheses should be avoided before age 40 years.
- Contraindications to percutaneous mitral commissurotomy include:
    - Mitral valve area >1.5 cm^2
    - Left atrial thrombus
    - More than mild mitral regurgitation
    - Severe or bicommissural calcification
    - Absence of commissural fusion
    - Severe concomitant aortic valve disease or severe combined tricuspid stenosis and tricuspid regurgitation
    - Concomitant coronary artery disease requiring bypass surgery

QUALIFYING STATEMENTS

QUALIFYING STATEMENTS

- The European Society of Cardiology (ESC) Guidelines represent the views of the ESC and were arrived at after careful consideration of the available evidence at the time they were written. Health professionals are encouraged to take them fully into account when exercising their clinical judgment. The guidelines do not, however, override the individual responsibility of health professionals to make appropriate decisions in the circumstances of the individual patients, in consultation with that patient, and where appropriate and necessary the patient's guardian or carer. It is also the health professional's responsibility to verify the rules and regulations applicable to drugs and devices at the time of prescription.
- The committee emphasizes the fact that many factors ultimately determine the most appropriate treatment in individual patients within a given community. These factors include availability of diagnostic equipment, the expertise of interventional cardiologists and surgeons, especially in the field of conservative techniques, and, notably, the wishes of well-informed patients. Furthermore, owing to the lack of evidence-based data in the field of valvular heart disease, most recommendations are largely the result of expert

consensus opinion. Therefore, deviations from these guidelines may be appropriate in certain clinical circumstances.

IMPLEMENTATION OF THE GUIDELINE

DESCRIPTION OF IMPLEMENTATION STRATEGY

An implementation strategy was not provided.

IMPLEMENTATION TOOLS

Clinical Algorithm
Pocket Guide/Reference Cards
Slide Presentation

For information about availability, see the "Availability of Companion Documents" and "Patient Resources" fields below.

INSTITUTE OF MEDICINE (IOM) NATIONAL HEALTHCARE QUALITY REPORT CATEGORIES

IOM CARE NEED

Living with Illness

IOM DOMAIN

Effectiveness
Patient-centeredness

IDENTIFYING INFORMATION AND AVAILABILITY

BIBLIOGRAPHIC SOURCE(S)

Vahanian A, Baumgartner H, Bax J, Butchart E, Dion R, Filippatos G, Flachskampf F, Hall R, Iung B, Kasprzak J, Nataf P, Tornos P, Torracca L, Wenink A, Priori SG, Blanc JJ, Budaj A, Camm J, Dean V, Deckers J, Dickstein K, Lekakis J, McGregor K, Metra M, Morais J, Osterspey A, Tamargo J, Zamorano JL, Zamorano JL, Angelini A, Antunes M, Fernandez MA, Gohlke-Baerwolf C, Habib G, McMurray J, Otto C, Pierard L, Pomar JL, Prendergast B, Rosenhek R, Uva MS, Tamargo J. Guidelines on the management of valvular heart disease: The Task Force on the Management of Valvular Heart Disease of the European Society of Cardiology. Eur Heart J 2007 Jan;28(2):230-68. [232 references] PubMed

ADAPTATION

Not applicable: The guideline was not adapted from another source.

DATE RELEASED

2007 Jan

GUIDELINE DEVELOPER(S)

European Society of Cardiology - Medical Specialty Society

SOURCE(S) OF FUNDING

European Society of Cardiology

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FINANCIAL DISCLOSURES/CONFLICTS OF INTEREST

The Task Force members of the writing panels, as well as the document reviewers, are asked to provide disclosure statements of all relationships they may have which might be perceived as real or potential conflicts of interest. These disclosure forms are kept on file at the European Heart House, headquarters of the European Society of Cardiology (ESC), and can be made available by written request to the ESC President. Any changes in conflict of interest that arise during the writing period must be notified to the ESC.

GUIDELINE STATUS

This is the current release of the guideline.

GUIDELINE AVAILABILITY

Electronic copies: Available in Portable Document Format (PDF) from the European Society of Cardiology (ESC) Web site.

Print copies: Available from Oxford University Press, Great Clarendon Street, Oxford, OX2 6DP, UK, Tel: +44 (0) 1865 353263, Fax: +44 (0) 1865 353774, Web site: http://www.eurheartj.oxfordjournals.org/.

AVAILABILITY OF COMPANION DOCUMENTS

The following are available:

- Valvular heart disease. Pocket guidelines. European Society of Cardiology, 2007. Available from the ESC Web site.
- Valvular heart disease. Educational slide set. European Society of Cardiology, 2007. Available from the ESC Web site.
- Recommendations for guidelines production. A document for Task Force Members responsible for the production and updating of ESC guidelines. 2006 Jun 28. 21 p. Available in Portable Document Format (PDF) from the ESC Web site.

Print copies: Available from Oxford University Press, Great Clarendon Street, Oxford, OX2 6DP, UK, Tel: +44 (0) 1865 353263, Fax: +44 (0) 1865 353774, Web site: http://www.eurheartj.oxfordjournals.org/.

PATIENT RESOURCES

None available

NGC STATUS

This summary was completed by ECRI Institute on June 19, 2007. This summary was updated by ECRI Institute on September 7, 2007 following the revised U.S. Food and Drug Administration (FDA) advisory on Coumadin (warfarin). This summary was updated by ECRI Institute on March 14, 2008 following the updated FDA advisory on heparin sodium injection. This summary was updated by ECRI Institute on March 21, 2008 following the FDA advisory on Erythropoiesis Stimulating Agents. This summary was updated by ECRI Institute on August 15, 2008 following the U.S. Food and Drug Administration advisory on Erythropoiesis Stimulating Agents (ESAs).

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Date Modified: 9/15/2008


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